HERMIONE news

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Impacts on the Deep-sea Ecosystem by a Severe Coastal Storm

Authors: Sanchez-Vidal A, Canals M, Calafat AM, Lastras G, Pedrosa-Pàmies R, Menéndez M, Medina R, Company JB, Hereu B, Romero J, Alcoverro T.

Scientists from University of Barcelona have recently published HERMIONE results in the journal PLoS ONE, showing that the effects of coastal storms extend to the deep-sea environment. This paper has generated some great coverage in the media including the Science NOW section ("Big storms roil even the deep", 1 February 2012.) of the Science Magazine.

Major coastal storms, associated with strong winds, high waves and intensified currents, and occasionally with heavy rains and flash floods, are mostly known because of the serious damage they can cause along the shoreline and the threats they pose to navigation. However, there is a profound lack of knowledge on the deep-sea impacts of severe coastal storms. Efforts to understand the deep-sea environmental implications of such extreme weather perturbations have been hampered by the lack of concurrent measurements of key parameters such as near bottom flows or sediment characteristics. In this paper, researchers from University of Barcelona present a unique data set showing how one of the most extreme coastal storms of the last decades lashing the Western Mediterranean Sea rapidly impacted the deep-sea ecosystem.

The storm hit the Catalan coast (Figure 1) the 26th of December 2008, with maximum eastern winds

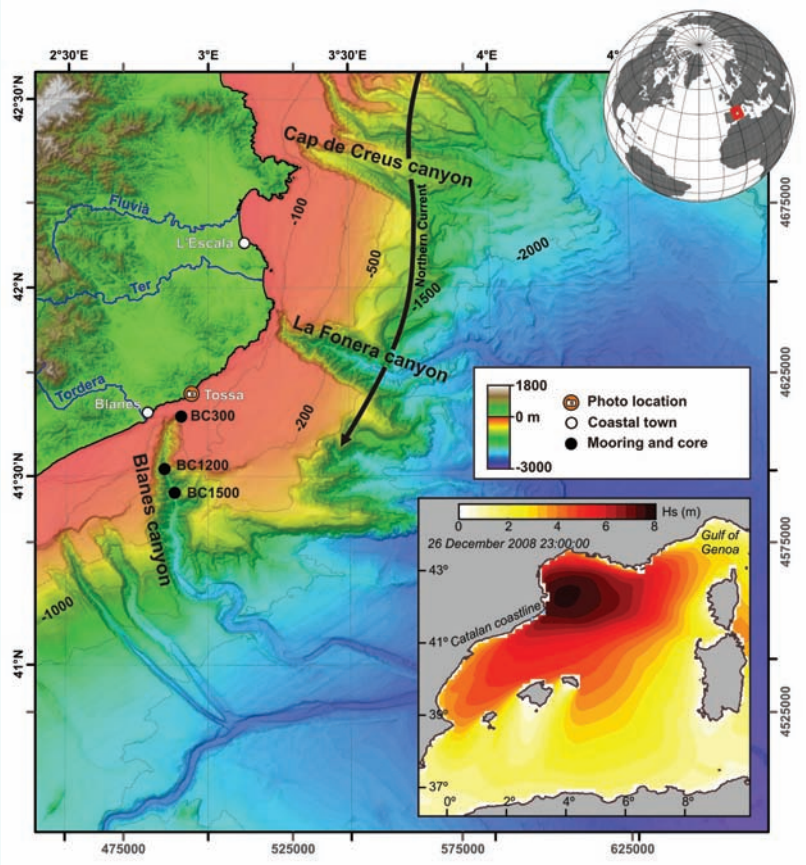

Figure 1. Bathymetric map of the Catalan margin and location of the moorings with sediment traps and currentmeters (black dots), and the scuba diving photo location (orange dot). Arrow indicates the direction of the Northern Current. The inset shows the spatial variability of the significant wave height the 26th December 2008 calculated with an atmospheric model in the Western Mediterranean Sea.

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of up to 20 m s-1, wave height in excess of 14m, wave periods up to 14s and a return period of more than 100 years. The high wave and current induced shear stress at the sea floor initiated the movement of large amounts of shelf sediments, which abraded and buried benthic communities as documented after scuba diving inspections (Figure 2). In rocky substrates, algal cover, population of sea urchins, and colonies of long-lived gorgonians nearly disappeared by abrasion. In sandy substrates, Posidonia oceanica seagrass beds were either seriously buried, or unearthed and uprooted. The storm mobilized and dropped large volumes of sand and carbonate debris to the upper reaches of the head of the Blanes submarine canyon (Figure 3). In addition, the storm lead to the remobilization of a shallow-water reservoir of marine organic carbon (more than 5.5 tonnes of particulate organic carbon) associated with fine particles that were redistributed across the deep basin (Figure 3).

Therefore, this research shows that in spite of their catastrophic effect on the coastal communities (or, more exactly, thanks to it), storms of high magnitude largely contribute to the sustainment of the deep ecosystem through the episodic supply of large volumes of organic carbon mostly along submarine canyons. This adds a new view to the current understanding on the impacts that climate-driven phenomena may have on deep-sea ecosystems, and consequently, on their living resources.

Figure 2. Photographs of the impact of the coastal storm in shallow water. Above, loss of approx. 1 m of sandy sediments. Below, uprooting of shoots of Posidonia oceanica. The extensive reworking of sediments by currents during the storm remobilised the shallow water reservoir of carbon and redistributed it across the deep basin. Credits for photographs: Jordi Regàs.

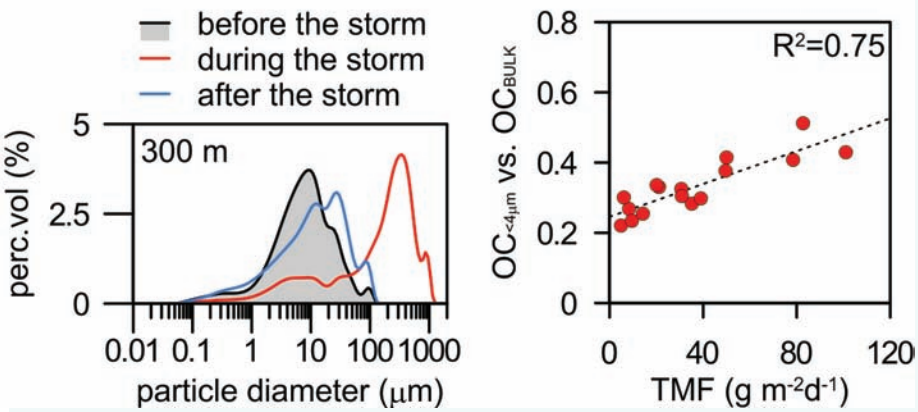

Figure 3. Left: Grain size distribution in settling particles at the head of the Blanes canyon before (black line), during (red line) and after (blue line) the storm. Right: relationship between total mass flux (TMF) and OC contained in the fine (<4 μm) fraction at 300, 1200 and 1500 m of water depth. A linear regression of the data implies that hydrodynamic forcing drives both TMF and OC loading of particles in the deep sea.

Reference:
Sanchez-Vidal A, Canals M, Calafat AM, Lastras G, Pedrosa-Pàmies R, Menéndez M, Medina R, Company JB, Hereu B, Romero J, Alcoverro T. (2012) Impacts on the Deep-Sea Ecosystem by a Severe Coastal Storm. PLoS ONE 7(1): e30395. doi:10.1371/journal.pone.0030395

Walking amoung deep-sea carbonate mounds

AUTHOR: Jean-Pierre Henriet and the COCARDE Moroccan field seminar participants

In the afternoon of Thursday 27 October 2011, a fleet of seven 4WD vehicles cruising off-road in the eastern Anti-Atlas Mountains of Morocco reached the Hamar Laghdad range. In amazement, some 30 Moroccan and European marine carbonate system researchers set foot on a pristine, 400 million year old seafloor, carbonate mounds towering 20 to 30m high around them like natural pyramids,. For the HERMIONE scientists, the Pen Duick Escarpment off Larache came alive. Tens of thousands of years of sand blasting has delicately removed the petrified muds that had draped the amazing carbonate world of the Devonian seas. While heated discussions had dominated the early part of the day, the junior and senior scientists were speechless as they walked among the mounds, touched their flanks, climbed their peaks, overlooking an astonishing seascape as the sky glowed red: as the sun set, a sand storm started up, as if the desert wished to recover its secrets. None of us understood how the drivers managed to navigate to our desert lodge, a 30 km off-road night drive with a visibility of a few meters.

Above: The road to the Hamar Laghdad mounds

The next morning, after a briefing on the flanks of the golden dunes of Merzouga, our party decided to head for the Carboniferous mounds of Hammou Ghanem, close to the Algerian border. Under the discrete protection of a heavily-armed police escort, our team experienced once more the very same excitement. This time, mound ranges of the Porcupine Seabight came to life: totally different actors, remarkably similar plays, over hundreds of millions of years. The magic works again. Later in the evening, seated around a rich Moroccan table, the scientists were unanimous: this is world heritage.

Above: The COCARDE field party walking among the mounds.

Developing mound heritage routes for science and capacity building is one of the objectives of COCARDE, which stands for Cold-Water Carbonate Reservoir Systems in Deep Environments. Born out of EC and ESF-sponsored research projects focusing on cold-water corals and carbonate mounds, COCARDE navigates from the recent to the deep past to better grasp the fundamental processes of carbonate build-up – how Life builds Geology. On its way through geological time, COCARDE meets with industry, which taps giant hydrocarbon reservoirs in similar fossil carbonate systems. COCARDE develops as a curiosity- and exploration driven project, with its roots in extreme environments and a focus on processes. While walking on the mounds, it opens up to frontier research in carbonate systems – any temperature, any depth, any actors, marine and lacustrine.

The strength of the operational structure of COCARDE lies in its distributed management. The network activities wax and wane with multiple resources, while keeping tack. The 2011 Morocco workshop and field seminar was co-funded by COCARDE-International Coordination Action (FWO Flanders, IOC-UNESCO) and COCARDE-European Research Network. The latter ESF network (2011-2016) is supported by Switzerland, Germany, The Netherlands, Belgium, Denmark and Italy. However, it is an open network, and other countries with significant carbonate research are most welcome to join.

Food for thought: The (un)importance of labile detritus in faunal diets at the Porcupine Abyssal Plain

AUTHOR: Dick van Oevelen, NIOO-KNAW

Food is a scarce resource in the deep-sea. The absence of light implies that no photosynthesis is possible and organisms in deep-sea sediments are living on detritus that is produced in the sunlit parts of the upper ocean and settles on the seafloor. After being deposited, the fresh phytodetritus is diluted by a large stock of sedimentary detritus. This results in a mixture ranging from fresh material to detrital matter that has been subject to several degradation steps. Typically, fresh detritus is of better quality, and present in low concentration, whereas degraded detritus is less palatable but present in large amounts. Although it is known that the input of detritus can be a significant driver of changes in the benthic food web, it is unclear how important this fresh food source is in diets of deep-sea fauna, because it is difficult to separate the uptake of fresh detritus from that of the detritus already present in the sediment.

One way to experimentally study the faunal uptake of fresh detritus is by adding pre-cultured algae, which are deliberately enriched in the isotope 13C, to the seafloor. Uptake of algae will show by enrichment of 13C in benthic fauna. This experimental approach however does not quantify the uptake of sedimentary detritus, so it remains difficult to assess the role of fresh detritus in the total diet. A modeling technique which has been developed at the NIOZ-Yerseke uses physiological data to infer total food demands by benthic fauna. When this model is extended with data of 13C tracer studies it becomes possible to quantify the role of fresh detritus in the diet of benthic fauna.

Above: PhD student Libby Ross holds a large holothurian collected from the Porcupine Abyssal Plain. Image: Leighton Rolley

This modeling methodology has now been applied to the Porcupine Abyssal Plain (Van Oevelen et al. In press), a station for which all necessary data is available from previous studies. It proved to be possible to combine all physiological data with the data from a tracer experiment performed at this site (Fig. 1). Surprisingly, it appeared that the contribution of fresh detritus in the diets of the benthic fauna was very small: the diet contribution of fresh detritus was <5% for almost all benthic organisms. The megabenthos, such as holothurians, was however not represented in the tracer experiment and diet contribution for this group could not be established. The model evidently shows a limited role of labile detritus for many organisms in the food web. This indicates that changes in the benthic community may lag behind changes in the export of detritus from the upper water column due to climate change. Long-term monitoring programs are therefore indispensible to follow the changes in the benthic community.

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A window on the effect of deep-sea bottom trawling on the Pacific coast

AUTHORS: Maéva Gauthier[1], S. Kim Juniper[1], J. Vaughn Barrie[2], Rosaline R. Canessa[1], James A. Boutillier[3]

Corresponding author: Maéva Gauthier: maeva@uvic.ca

[1] University of Victoria, Victoria, British Columbia (BC) Canada, [2] Natural Resources Canada, Pacific Geoscience Centre, Sidney, BC Canada, [3] Fisheries and Oceans, Pacific Biological Station, Nanaimo, BC Canada

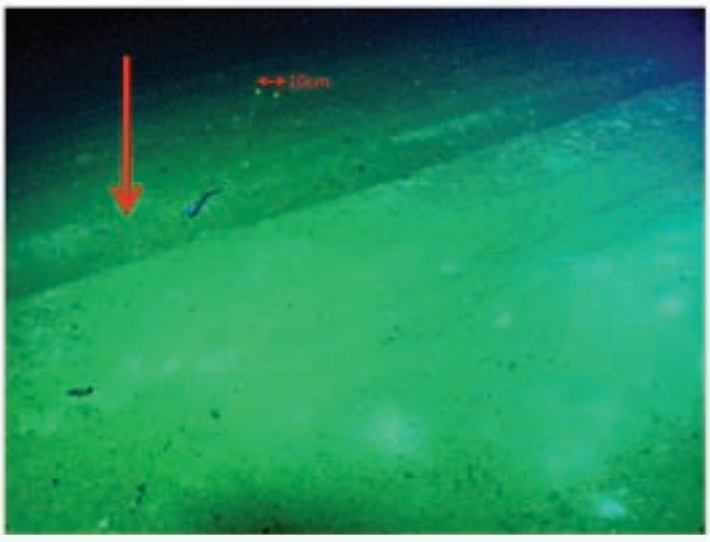
The study area is located on the continental slope off the West coast of Canada, 60 nautical miles off Vancouver Island. Two transects (12km and 30km) were carried out at depths between 300m and 1,400m. Copyright: Map provided by Geological Survey of Canada.

Launched in 2008, the Canadian Healthy Oceans Network (CHONe) is a national research program and a strategic university/government partnership, created to provide new insights into biodiversity in Canada's three oceans, the Atlantic, the Pacific, and the Arctic. In 2010 CHONe entered into strategic partnerships with HERMIONE and several other international programs to enhance its training plan and science activities with the goal of improving existing and developing new tools for sustainable oceans and effectively communicating research findings to science and policy users in Canada and globally. Investigating the impacts of human activities on the deep sea benthos is a research area pursued by both CHONe and HERMIONE researchers.

As part of the Canadian Healthy Oceans Network (CHONe), my master's research looked at the impact of bottom trawling on deep-sea benthic epifauna (surface of the seabed) combining video and sonar data. The study took place on the continental slope off the West coast of Canada. Bottom trawling is known to have considerable impacts (Kaiser et al. 1998, Collie et al. 2000), but is not well documented in the deep-sea on soft-bottom substratum. Deep-sea bottom trawling started in the 1990s on the West coast of Canada and trawl nets can be as wide as 70m with typical tows lasting about 7 hours. The main target is the rockfish Sebastolobus spp., also known as shortspine and longspine thornyheads, considered as a delicacy on the Japanese market (COSEWIC 2007).

In order to quantify the impacts of bottom trawling, two video transects (30km and 12km) were carried out from 300m to 1,400m during a cable route survey for NEPTUNE Canada in August 2007. A challenge during the research cruise was to find untrawled areas: it was pretty much impossible to compare untrawled vs trawled areas at the same depth range. Another challenge is that trawling is concentrated in an oxygen minimum zone. It could seem counterintuitive to have more fishing intensity in a low productive area; however, thornyheads spend most of their life in the oxygen minimum zone and longspine thornyheads are considered low-oxygen specialists (Jacobson & Vetter 1996).

Department of Fisheries and Oceans Canada (DFO) recently provided fishing effort data at our transect locations and a list of species caught in this area. Fishing



Above: Trawl-door marks were visible in videos and high-resolution scanning-sonar imagery. The highest trawling intensity was located between 600m and 1,100m. Copyright: NEPTUNE Canada

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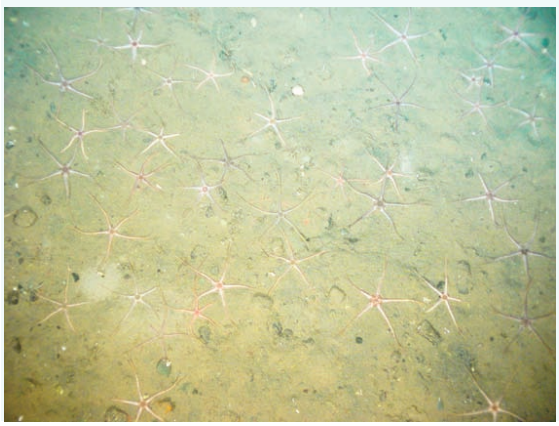
effort data confirmed the scanning-sonar to be a great tool to quantify trawling intensity: for ~500 fishing tows, we documented 1,000 trawl-door marks visible on the scanning-sonar imagery. It also means that trawl marks remain visible for at least 10 years on the seabed.

Statistical results have shown differences in species composition, distribution, and total abundances between low and high trawling intensities. Measurements of substratum softness revealed consistent soft sediment and water masses didn't show any drastic changes (temperature and salinity gradually changing). Total abundances were very low in the highly trawled area. Looking at it more closely, faunal aggregations (holothurians and ophiuroids) were merely absent in the high trawling intensity area (41-71+ trawl marks per 500m) compared to the low trawling intensity area (0-40 marks/500m). These 'patches' were often dominating the seabed in low trawling intensity areas. Looking at the list of species caught from DFO shown that ophiuroids were present in the depth range of the highly trawled area in the years before the video survey. Another difference in terms of species composition was that sponges and sea whips were much more present in low trawling intensity areas.

So what's next? For this study, in situ oxygen concentration levels were not available for the same year, but long-term vertical oxygen gradients show a persistent oxygen minimum zone on the continental slope starting around 500m depth. Future surveys will explore the horizontal oxygen gradients and epifauna present. Bottom trawling continues, making hard to measure any recovery process or separate completely trawling and oxygen influences. Knowing that the main target fish in our survey area is of special concern on the Species at risk Act in Canada since 2007 (COSEWIC 2007), I want to link my findings to management considerations. Bottom trawling is widespread off British Columbia (>38,000km2) and there is a need to create refuges for fish, especially in the deep-sea, where slow growth, long-living organisms prevail. As a CHONe student, I certainly hope that my research will help develop scientific guidelines for conservation and sustainable use of marine biodiversity resources.

Above: Glass sponges, thornyhead rockfish, and tanner crab are part of the epifauna present on the continental slope at depths between 300m and 1,400m. Bottom trawling fisheries target Thornyheads in this area. Copyright: NEPTUNE Canada

Above: The holothurian Scotoplanes globosa (also called Sea pig) formed aggregations and was very rare in the highly trawled area and very concentrated in the deeper section of the transect. Copyright: NEPTUNE Canada



Left: Faunal aggregations, such as ophiuroids in this picture, were merely absent from highly trawled areas, while dominating the seabed in low trawled areas. Copyright: NEPTUNE Canada

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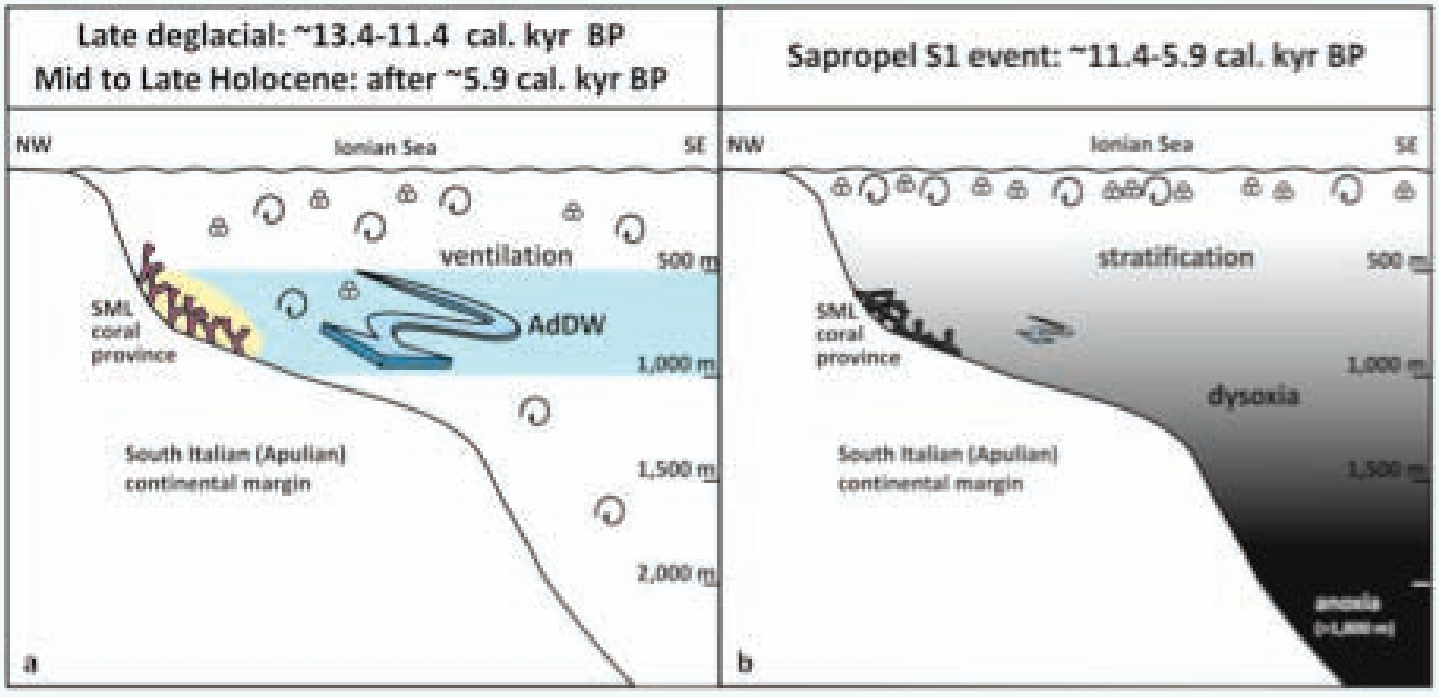
New study on Mediterranean cold-water corals reveals their sensitivity on low oxygen contents

MARUM, Bremen, Germany

A recently published HERMIONE study on continuous sedimentary records from an eastern Mediterranean cold-water coral site revealed a temporary extinction of these deep-sea organisms during the Early to Mid Holocene (11.4–5.9 cal. kyr BP). The timing of the corals' demise coincides with the sapropel S1 event, during which the deep eastern Mediterranean basin (>1,800 m) turned anoxic. The results of this study show that during the sapropel S1 event low oxygen (dysoxic) conditions of 2 ml l-1 even extended to intermediate depths (~600 m), where the cold-water corals formerly thrived. The corals clearly suffered under these extreme conditions, which might have had a negative effect on their growth rate and reproductive processes, and eventually caused their temporary extinction. This very first evidence for the sensitivity of cold-water corals to low oceanic oxygen contents suggests that the projected expansion of tropical oxygen minimum zones resulting from global change will threaten cold-water coral ecosystems in low latitudes in the same way that ocean acidification will do in the higher latitudes.



Above: Schematic NW-SE cross-section across the Apulian margin showing the Santa Maria di Leuca (SML) cold-water coral province in the Ionian Sea. a: Phases of sustained coral growth in the late deglacial and Mid to Late Holocene that were associated with the formation of Adriatic Deep Water (AdDW) resulting in enhanced bottom currents and a well-ventilated water column. b: Temporary demise of cold-water corals during Early Holocene sapropel S1 event in the eastern Mediterranean Sea. Anoxic (>1,800 m water depth) to dysoxic (~500-1,800 m water depth) conditions were caused by enhanced water-mass stratification associated with increased freshwater input, enhanced eutrophication and reduced AdDW formation.

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European workshop on genomics, in Český Krumlov, Czech Republic.

AUTHOR: Chrysoula Gubili, National Oceanography Centre, Southampton

The European Workshop on Genomics is being held in Český Krumlov located in the Southern Bohemia region of the Czech Republic, an idyllic location of central Europe. The workshop attracts many scientists as it is known for the teaching quality and knowledge that offers to young researchers. This year, 72 scientists from different scientific communities and over 20 countries participated at the third two weeks length Workshop, making it a very promising event.

The sessions combined lectures and computer practicals in the morning, afternoon and evening giving insights on the theory and applications on this broad spectrum of research area (Comparative Genomics, Transcriptomics, Metagenomics, Pathogenomics, Population and Evolutionary Genomics). During the computer practicals, large datasets generated by modern sequencing technologies were analysed and managed, providing an efficient and effective training to the participants. Moreover, the outputs as well as the difficulties were discussed with the instructors to understand the full potentials of the respective field.

On a personal note, it was extremely beneficial to be able to talk to researchers in similar positions about their work, share our thoughts and learn more about certain areas in science. Additionally, I was able to have direct discussions with lecturers, top on their field regarding my own research, whilst ask questions on experimental design, logistics, and feasibility of a project.

I am most grateful to the HERMIONE Training Bursary for their support through this Workshop, which allowed me to gain valuable knowledge towards an emerging discipline.

Right: A window view of the beautiful town of Český Krumlov

Advanced interdisciplinary course "data tools in ecology- module 2: data exploration, regression, GLM, GAM - with introduction to R.

AUTHOR: Christopher Pham

Biological sciences, like anthropology or chemistry are sciences tightly linked to statistics, however, although they are sometimes taught during academic courses, they seldom appeal to scientists whose main interest doesn't lie directly into numbers. Yet, the mastering of statistical tools is mandatory to analyze and interpret data. As a biologist, these skills are necessary but rare are the opportunities to discover in depth the secrets of efficient statistics.
The training bursary offered by HERMIONE was a great chance for me to discover, through an intense week, the world of statistics, more specifically what I was interested in, General Linear Models and General Additive Models. This foreign world was made accessible thanks to excellent tutoring, engaging lectures, and precise applied examples and above all, in a joyful and rich atmosphere. The dive into this particular science was made easy and was highly beneficial for my fellow trainees and myself.

In terms of the course content, a good balance was reached between learning the software R, the statistical theory and how to improve sampling design. For each topic, there was a theoretical lecture followed by a case study applying the newly learnt statistical tool to a particular research question on a biological system. This was followed by an exercise that allowed each of us to go through the entire analyzing and interpretation process on our own.
Although the course was organized by the University of Coimbra, it was delivered by Highland Statistics staff; Alain Zuur (statistician) and Elena Ieno (biologist) who are well experienced trainers. With their distinct backgrounds, they managed to offer keys to the world of statistics to non-specialists. Their experience and good teaching skills helped me understand the application of the statistical theories to my own personal interests.

Additionally to the quality of the course, the surroundings of the training location brought to this experience a particular feel. Even though I did not have time to visit Coimbra with attention, I had time to taste the delicious food and feel the energy of one of the oldest universities of Europe.

Another essential aspect of the course was its diversity. The group of trainees was composed of different nationalities and regrouped people coming from New Zealand, Poland or the United States. It also brought together scientists of different trade like terrestrial ecologists, but also bird ecologists, mud ecologist... As such, the training course enabled dialogue between various backgrounds, approaches, cultures and research topics that lead to multi-disciplinarity perspectives.

As many young biologists, I lacked good control and understanding of this type of statistics. Now, after this course, I feel more at ease with the power and methodologies and approaches of statistics, and most particularly, feel that I master better GLM and GAM. I am working with fisheries data and henceforth, need to be able to understand standardization techniques (Maunder and Punt, 1999). This is an essential tool for my research and this will help me to correctly standardize my data and help for example, to understand what factors might influence the bycatch of deep-water corals in longline gear.

HERMIONE nominated for inclusion in FP7 "Best Marine Projects"

HERMIONE may be following in the footsteps of its predecessor project HERMES as one of the top projects of FP7! Our EC Project Officer Ana Teresa Caetano has recently put us forward for inclusion in the FP7's "Best Marine Projects" document…watch this space!

HERMIONE and HERMES articles now visible in Google Earth's base layer

The HERMIONE project office has been working with GoogleEarth to get all of our HERMES and HERMIONE posts onto their base layer. This means that now anybody can see the HERMIONE and HERMES science posts without having to download any extra files! This is great news for us as it is something we have been trying to do since HERMES – and it's great for raising awareness of the deep-sea and our research. It is an ongoing project, so if you have any interesting snippets of science, please get in touch with Abi (abigail.pattenden@noc.ac.uk).

HERMIONE annual meeting 2012

We have set provisional dates for the HERMIONE annual meeting 2012. For what will be our final meeting, we have decided to go full circle and finish where we started – in the Hotel Tivoli Carvoeiro, Faro, Portugal.

This lovely hotel has been the site of several HERMES meetings, and it will be great to go back there for one last time.

Dates: 10 – 14 September 2012
Location: Hotel Tivoli Carvoeiro, Faro, Portugal

Confirmation and more details will follow shortly.

HERMIONE workshop: Anthropogenic impacts & climate change

8-10 May 2012, Barcelona

Aims of the workshop

1. To provide benchmark assessment on anthropogenic impact in the deep sea
2. To provide benchmark assessment on climate change impact in the deep sea
3. Write a protocol for the qualification and quantification of litter in deep sea

Programme (draft)

Tuesday 8th May

12.30 Arrive and buffet lunch
14.00 Welcome and objectives – Eva
14.15 Outline AI outcomes – Eva (see list below)
14.30 Outline CC outcomes – Paul
14.45 Short presentations by participants on data available/results and discussion (10 min each)
15.30 Coffee
16.00 Continue short presentations and discussion
17.00 Allocation of tasks and planning for discussions: produce a guideline to focus discussions on following days.
18.00 End of day

Wednesday 9th May

09.00 Divide into working groups and star discussions on each task
11.00 Coffee
11.30 Continue working group discussions
13.00 Buffet lunch
14.00 Continue working group discussions
15.30 Coffee
16.00 Plenary: short presentations by WG leads and writing task/product preparation assignments
17.00 End of day

Thursday 10th May

09.00 Writing groups
12.30 Plenary session: summary of workshop achievements and organization for "homework"
13.30 End of workshop

The aims of the workshop directly address three HERMIONE deliverables due at the end of the project (DX.1, DX.2, DX.3). These deliverables encompass work from all work packages, and as such we would like as many people to attend as possible.

Further details will be sent out shortly. For more information, or to register interest, please contact Eva Ramirez-Llodra: ezr@icm.csic.es.

Image above: cold-water corals in CoraLab in the Azores. Copyright: Pedro Ribeiro, IMAR-DOP, University of the Azores